33. ✓e) regression

a)

x	y
0	~~297.3~~ 306.4
5	~~272.1~~ 250

$\frac{250-306.4}{5-0}$

$-11.4 \quad \frac{\text{bill } \$}{\text{yr}}$

f) reg

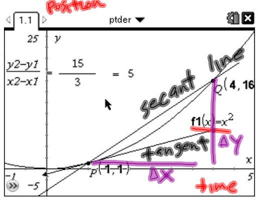
How fast at 2013

X	Y
12.9	
13	
13.1	

Aug 28-9:18 AM

2.4b Instantaneous Rate of Change

Estimate the instantaneous velocity at t=1 x=1



$\text{rhdq} = \frac{16-1}{4-1} = \frac{15}{3} = 5$

$\lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} \overset{?}{=} 2$

Same (inst. velocity $\overset{?}{=} 2$

slope of tangent line $= 2$

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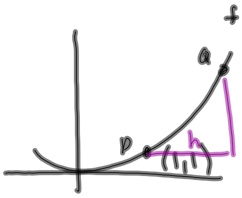
Find the exact instantaneous velocity at t=1

$\lim_{h\to 0} \frac{f(1+h) - f(1)}{h}$

$f(x) = x^2$

$(1+h, (1+h)^2)$



$\lim_{h\to 0} \frac{(1+h)^2 - 1}{h}$

$\lim_{h\to 0} \frac{\cancel{1}+2h+h^2-\cancel{1}}{h}$

$h = \Delta x$

$\lim_{h\to 0} \frac{\cancel{h}(2+h)}{\cancel{h}} = \lim_{h\to 0} 2+h = 2$

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$\boxed{\lim_{h\to 0} \frac{f(a+h) - f(a)}{h}}$

p q0

inst. velocity at $x=a$

slope of tan line at $x=a$

Aug 28-10:08 AM

Example 3 Find the equation of the tangent to the parabola y=x^2 at x=2

$$f(x)=y=x^2$$

$$\lim_{h\to 0}\frac{f(2+h)-f(2)}{h}=\lim_{h\to 0}\frac{(2+h)^2-2^2}{h}$$

$$=\lim_{h\to 0}\frac{\cancel{4}+4h+h^2-\cancel{4}}{h}=\lim_{h\to 0}\frac{\cancel{h}(4+h)}{\cancel{h}}$$

$$=\lim_{h\to 0}4+h=4=m_{tan}$$

tan line: $y=4(x-2)+4$ $\quad x=2 \quad y=4$

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Example 5 Find an equation for the normal to the curve y=4-x^2 at x=1

$\perp$ to tan $\quad y=4-x^2$

$$m_{\perp}=\frac{-1}{m_{tan}}$$

$$m_{tan}=\lim_{h\to 0}\frac{f(1+h)-f(1)}{h}$$

$$\lim_{h\to 0}\frac{4-(1+h)^2-3}{h}=\lim_{h\to 0}\frac{4-(1+2h+h^2)-3}{h}$$

$$\lim_{h\to 0}\frac{\cancel{4}-\cancel{1}-2h-h^2-\cancel{3}}{h}=\lim_{h\to 0}\frac{\cancel{h}(-2-h)}{\cancel{h}}=-$$

$m_{tan}=-2 \quad m_{\perp}=\frac{1}{2} \quad$ point $(1,3)$

normal: $y=\frac{1}{2}(x-1)+3$

Aug 24-10:24 AM

Example 6 Find the speed of a falling rock at t=1 if the distance it falls is y=16t^2

Aug 24-10:25 AM